XODUS ENTERS PHASE 2 OF PIONEERING RESEARCH INTO MULTIPHASE FLOW

International energy consultancy Xodus Group, and Dutch innovation company TNO, have completed the first phase of a pioneering joint industry project (JIP) into the dynamic forces which affect the integrity of piping systems, in particular through multiphase flow. The second phase of the project, which is expected to be run across three stages, is now open for new participants to join.

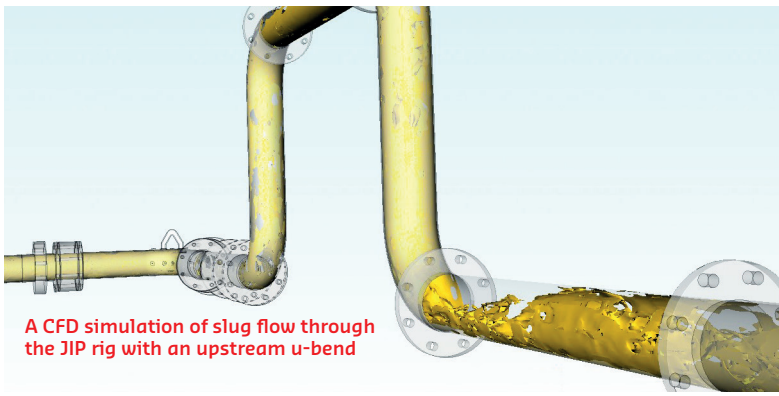
Eight companies were involved in the first phase of the project: BP, Statoil, Total, Suncor, Shell, Lundin, Aker Solutions and FMC. TNO carried out the bulk of the test work at their facilities in The Netherlands, while Xodus managed the programme and developed CFD schemes to be able to reproduce the measured results. Based on the outcome of analyses by both companies, new scaling rules were produced. Additionally, CD-adapco provided software (STAR-CCM+) and carried out simulations in support of the JIP.

The JIP rig with an upstream u-bend with slug flow through the system

Multiphase flow, the passage of more than one fluid, gas or chemical substance through a pipeline, can cause flow induced vibration (FIV). This is an increasing concern on subsea (and topsides) production piping systems. As data is limited in this highly technical arena, the aim of the JIP is to investigate and understand the forces induced by multiphase flow on piping systems, and generate validation data for multiphase computational fluid dynamics (CFD) to model and analyse its occurrence.

Phase 1 was valued at more than £500,000 and involved testing on a 1.5 R/D stiff bend for a range of flow conditions. The inlet pipe to the bend had three configurations: straight, u-bend vertical and u-bend horizontal. Detailed measurements were made to analyse the forces acting on the bend, pressure and void fraction distributions upstream, downstream and within the bend. Computational fluid dynamics (CFD) calculations were carried out to compare test results with a range of flow conditions.

Phase 2 is actively seeking additional sponsors and will look to extend the work carried out in Phase 1 to cover a range of bend radii. It aims to begin in autumn this year. The scope is as follows:



A CFD simulation of slug flow through the JIP rig with an upstream u-bend

- Testing additional bend configurations
- Preparation for testing at in service conditions for Phase 3
- Additional CFD studies

The goal is to raise awareness of this complex issue and increase knowledge to incorporate into advance screening, simulation and prediction models.

"This project will extend intelligence from small scale laboratory tests to 'industrial scale' piping systems," said Mike Lewis, global lead – computational fluid dynamics with Xodus Group.

"As E&P activity goes ever deeper and into more extreme environments, and as subsea equipment becomes more complex, with the additional subsea processing for example, the potential increases for FIV to go unnoticed.

"The JIP is addressing this area of uncertainty in the industry and will provide a benchmark in order to carry out more accurate design calculations and prediction work. This will ultimately improve piping integrity, potentially increase production, and mitigate risk in this high-consequence arena."

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"The experimental results thus far have given us new insights on how to improve the mechanical integrity analyses of subsea templates," said Erik Nennie, project manager – heat transfer and fluid dynamics with TNO. "The outcome of the next phases will further improve the modelling tools for integrity analysis, as both design and operation of subsea templates can greatly benefit from these studies."